

What is Claimed is:

1 1. A clamp assembly for clamping a riser brace to a riser pipe of a jet pump
2 assembly in which the riser pipe has a central longitudinal axis and the riser brace has
3 first and second side members extending from a yoke attached to the riser pipe with the
4 side members extending transverse to the central longitudinal axis on opposite sides of
5 the riser pipe, said clamp assembly comprising

6 first and second clamp members mountable on the riser brace respectively on the
7 opposite sides of the riser pipe, said first clamp member including a clamp body
8 comprising a coupling portion, a lever arm portion and an abutment surface on said lever
9 arm portion for being disposed along the riser pipe opposite the yoke, and a pivot
10 between said coupling portion and said lever arm portion defining a pivot axis for said
11 clamp body extending in the same direction as the central longitudinal axis of the riser
12 pipe and about which said clamp body is pivotal, said second clamp member including a
13 clamp body comprising a coupling portion, a lever arm portion and an abutment surface
14 on said lever arm portion of said second clamp member for being disposed along the
15 riser pipe opposite the yoke, and a pivot between said coupling portion of said second
16 clamp member and said lever arm portion of said second clamp member defining a pivot
17 axis for said clamp body of said second clamp member parallel to said pivot axis for said
18 first clamp member and about which said clamp body of said second clamp member is
19 pivotal;

20 first and second engagement elements respectively structurally connected to said
21 first and second clamp members and securable on the riser brace with the yoke
22 disposed between the riser pipe and said first and second engagement elements; and

23 an operating member coupling said coupling portions in spaced relation along a
24 clamping axis perpendicular to said pivot axes with the riser pipe disposed between said
25 clamping axis and said abutment surfaces, said operating member being operable to
26 move said coupling portions further away from one another along said clamping axis to
27 effect pivotal movement of said clamp bodies in unison and in opposite directions about
28 said pivot axes to force said abutment surfaces against the riser pipe at respective first
29 and second radial locations to apply radial forces to the riser pipe at the radial locations
30 and reacted by forces applied by said engagement elements to the yoke in parallel
31 directions and on the opposite sides of the riser pipe.

1 2. The clamp assembly recited in claim 1 wherein said first engagement
2 element is diagonal to said abutment surface of said second clamp member and said
3 second engagement element is diagonal to said abutment surface of said first clamp
4 member.

1 3. The clamp assembly recited in claim 1 wherein said operating member
2 includes an externally threaded bolt having a central longitudinal axis defining said
3 clamping axis and having opposing ends, and keys respectively disposed on said
4 opposing ends, said keys being held in respective cavities within said coupling portions
5 while said bolt is rotatable to move said keys longitudinally away from one another along
6 said bolt.

1 4. The clamp assembly recited in claim 1 wherein said lever arm portions
2 respectively have arcuate inside surfaces to curve around an outer circumference of the
3 riser pipe.

1 5. The clamp assembly recited in claim 5 wherein said abutment surfaces are
2 respectively defined by protrusions extending radially inwardly from said arcuate inside
3 surfaces.

1 6. The clamp assembly recited in claim 1 and further comprising first and
2 second attachment members on which said first and second clamp members are
3 respectively pivotally mounted, and a connecting member for connecting said first and
4 second attachment members on the riser brace in adjustable spaced relation along a
5 connecting axis parallel to said clamping axis, said engagement elements being
6 disposed respectively on said attachment members.

1 7. A clamp assembly for clamping a riser brace to a riser pipe of a jet pump
2 assembly in which the riser pipe has a central longitudinal axis and the riser brace has
3 first and second side members extending from a yoke attached to the riser pipe with the
4 side members extending transverse to the central longitudinal axis on opposite sides of
5 the riser pipe, said clamp assembly comprising

6 a first attachment member for being disposed on the riser brace and having a
7 retaining member for being disposed along the first side member of the riser brace and
8 having an engagement element for being disposed along the yoke of the riser brace;

9 a second attachment member for being disposed on the riser brace and having a
10 retaining member for being disposed along the second side member of the riser brace
11 with the riser brace between said retaining members and having an engagement
12 element for being disposed along the yoke of the riser brace with the yoke between said
13 engagement elements and the riser pipe;

14 a connecting member connecting said attachment members in spaced relation
15 along a connecting axis perpendicular to the side members of the riser brace, said
16 connecting member being operable to decrease the space between said attachment
17 members along said connecting axis to obtain an attached position in which said
18 retaining members respectively engage the side members to secure the riser brace
19 between said retaining members;

20 a first clamp body pivotally mounted on said first attachment member and having
21 an abutment surface for being disposed along the riser pipe opposite said engagement
22 element of said first attachment member;

23 a second clamp body pivotally mounted on said second attachment member and
24 having an abutment surface for being disposed along the riser pipe opposite said
25 engagement element of said second attachment member; and

26 an operating member coupling said first and second clamp bodies along a
27 clamping axis and being operable to pivot said clamp bodies to a clamping position in
28 which said abutment surfaces contact and apply forces to the riser pipe whereby the
29 riser pipe and riser brace are clamped together between said abutment surfaces and
30 said engagement elements.

1 8. The clamp assembly recited in claim 7 wherein said abutment surfaces
2 contact and apply said forces to the riser pipe at locations radial and symmetrical to the
3 central longitudinal axis of the riser pipe and said engagement elements apply forces to
4 the yoke in parallel directions symmetrical with and on the opposite sides of the central
5 longitudinal axis of the riser pipe in the clamping position.

1 9. The clamp assembly recited in claim 7 wherein said retaining members
2 respectively comprise retaining walls in abutting engagement with the respective side
3 members in the attached position and between which the riser brace is secured in the
4 attached position, said connecting axis being perpendicular to said retaining walls.

1 10. The clamp assembly recited in claim 9 wherein said engagement elements
2 respectively comprise planar shear tabs in abutment with the yoke in the clamping
3 position, said tabs being perpendicular to said retaining walls.

1 11. The clamp assembly recited in claim 8 wherein said connecting member
2 includes a bolt adjustably connecting said first and second attachment members and
3 having a central longitudinal axis defining said connecting axis, said operating member
4 includes a bolt adjustably coupling said first and second clamp bodies and having a
5 central longitudinal axis defining said clamping axis parallel to said connecting axis, and
6 further including first and second pivots respectively mounting said first and second
7 clamp bodies on said first and second attachment members, said pivots respectively

8 defining pivot axes for said clamp bodies perpendicular to said connecting axis and said
9 clamping axis.

1 12. The clamp assembly recited in claim 7 wherein said engagement element
2 of said first attachment member is diagonal to said abutment surface of said second
3 clamp body and said engagement element of said second attachment member is
4 diagonal to said abutment surface of said first clamp body in the clamping position.

1 13. A mechanically reinforced weld between a riser pipe and a riser brace of a
2 jet pump assembly in a boiling water reactor, comprising

3 a jet pump assembly including a riser pipe having a central longitudinal axis and a
4 riser brace secured to said riser pipe, said riser brace comprising a yoke extending
5 transverse to said central longitudinal axis and first and second side members extending
6 in the same direction from said yoke in spaced relation on opposite sides of said riser
7 pipe with said riser pipe disposed between said side members, said riser brace having a
8 periphery including an outer peripheral portion and an inner peripheral portion, said yoke
9 having an outer surface along said outer peripheral portion and an inner surface
10 between said side members along said inner peripheral portion, and a weld along said
11 inner surface securing said riser pipe to said yoke; and

12 a clamp assembly comprising first and second attachment members attached to
13 said riser brace and having respective engagement elements in contact with said outer
14 surface of said yoke, first and second clamp bodies respectively pivotally mounted on
15 said first and second attachment members for pivotal movement about respective first

16 and second pivot axes on said opposite sides of said riser pipe, and an operating
17 member pivoting said first and second clamp bodies into engagement with said riser
18 pipe at respective first and second radial locations, said clamp bodies applying radial
19 forces to said riser pipe at said radial locations in the direction of said central longitudinal
20 axis and said engagement elements reacting said radial forces to clamp said riser pipe
21 to said yoke.

1 14. The mechanically reinforced weld recited in claim 13 wherein said outer
2 surface of said yoke is planar and said engagement elements are planar shear tabs in
3 abutment with said outer surface of said yoke.

1 15. The mechanically reinforced weld recited in claim 13 wherein each of said
2 side members has an outer lateral face along said outer peripheral portion and first and
3 second legs aligned in spaced parallel relation along said outer lateral face, said outer
4 lateral faces being parallel to one another and being perpendicular to said outer surface
5 of said yoke, said first and second attachment members including respective retaining
6 surfaces and retaining members each having a first retaining wall and a second retaining
7 wall perpendicular to said first retaining wall and in spaced parallel relation to said
8 retaining surface, and further including a connecting member connecting said first and
9 second attachment members along a connecting axis perpendicular to said outer lateral
10 faces, said connecting member connecting said first and second attachment members
11 on said riser brace with said first retaining walls in respective abutment with said outer
12 lateral faces to confine said riser brace between said first retaining walls, and said

13 second retaining walls extending respectively between said first and second legs with
14 said first legs respectively confined between said second retaining walls and said
15 retaining surfaces of said retaining surfaces of said attachment members.

1 16. The mechanically reinforced weld recited in claim 15 wherein said
2 operating member couples said first and second clamp bodies along a clamping axis
3 parallel to said connecting axis.

1 17. The mechanically reinforced weld recited in claim 15 wherein said first and
2 second pivot axes are parallel to said central longitudinal axis of said riser pipe and are
3 respectively defined by first and second pivot members respectively pivotally mounting
4 said first and second clamp bodies on said first and second attachment members.

1 18. The mechanically reinforced weld recited in claim 17 wherein each of said
2 clamp bodies comprises a coupling portion, a lever arm portion and a pivot portion
3 between said coupling portion and said lever arm portion receiving the corresponding
4 one of said pivot members, said coupling portions being disposed over said yoke, said
5 pivot portions being respectively disposed over said side members, and said lever arm
6 portions curving toward one another around said riser pipe.

1 19. The mechanically reinforced weld recited in claim 18 wherein said
2 operating member couples said coupling portions along a clamping axis perpendicular
3 to said pivot axes and parallel to said connecting axis.

1 20. The mechanically reinforced weld recited in claim 13 wherein said weld is
2 cracked and said clamp assembly clamps said riser pipe to said riser brace as a repair
3 to cracking of said weld.

1 21. A method of mechanically reinforcing the weld between a riser pipe and
2 riser brace of a jet pump assembly in a boiling water reactor in which the riser pipe has a
3 central longitudinal axis, the riser brace has a yoke transverse to the riser pipe and first
4 and second side members extending from the yoke in spaced relation on opposite sides
5 of the riser pipe, and the weld secures the riser pipe to the yoke with the riser pipe
6 disposed between the side members, said method comprising the steps of

7 attaching first and second attachment members of a clamp assembly to the riser
8 brace with respective first and second engagement elements of the attachment
9 members located along the yoke with the yoke disposed between the riser pipe and the
10 engagement elements;

11 pivoting first and second clamp bodies of the clamp assembly respectively
12 mounted on the first and second attachment members about respective pivot axes
13 extending in the same direction as the central longitudinal axis of the riser pipe to obtain
14 a clamping position in which the first and second clamp bodies are forced against the
15 riser pipe at respective first and second radial locations opposite the yoke and apply
16 radial forces to the riser pipe at the first and second radial locations in the direction of
17 the central longitudinal axis;

18 reacting the radial forces with forces applied by the engagement elements to the
19 yoke such that the clamp assembly clamps the riser pipe to the riser brace; and

20 leaving the clamp assembly in place to mechanically reinforce the weld.

1 22. The method recited in claim 21 wherein said step of pivoting includes
2 forcing respective abutment surfaces of the clamp bodies against the riser pipe at first
3 and second radial locations symmetrical to the central longitudinal axis of the riser pipe
4 and said step of reacting includes applying the forces of the engagement elements to
5 the yoke in parallel directions symmetrical to the central longitudinal axis of the riser
6 pipe.

1 23. The method recited in claim 21 wherein said step of attaching includes
2 connecting the attachment members on the riser brace in spaced relation along a
3 connecting axis perpendicular to the pivot axes.

1 24. The method recited in claim 23 wherein said step of connecting includes
2 constraining the riser brace against movement in a direction parallel to the central
3 longitudinal axis of the riser pipe and in a direction parallel to the connecting axis.

1 25. The method recited in claim 23 wherein said step of adjustably connecting
2 includes moving one or both of the attachment members relative to the other along the
3 connecting axis to draw the attachment members closer together.

1 26. The method recited in claim 25 wherein said step of pivoting includes
2 pivoting respective lever arm portions of the clamp bodies by extending respective

3 coupling portions of the clamp bodies away from one another along a clamping axis
4 perpendicular to the pivot axes and parallel to the connecting axis.

5 27. The method recited in claim 26 wherein said step of pivoting includes
6 pivoting the lever arm portions in unison and in opposite directions about the pivot axes.

1 28. The method recited in claim 21 wherein said steps of attaching, pivoting
2 and reacting are performed where the weld securing the riser pipe to the yoke is cracked
3 and said step of leaving includes leaving the clamp assembly in place as a repair for the
4 cracked weld.